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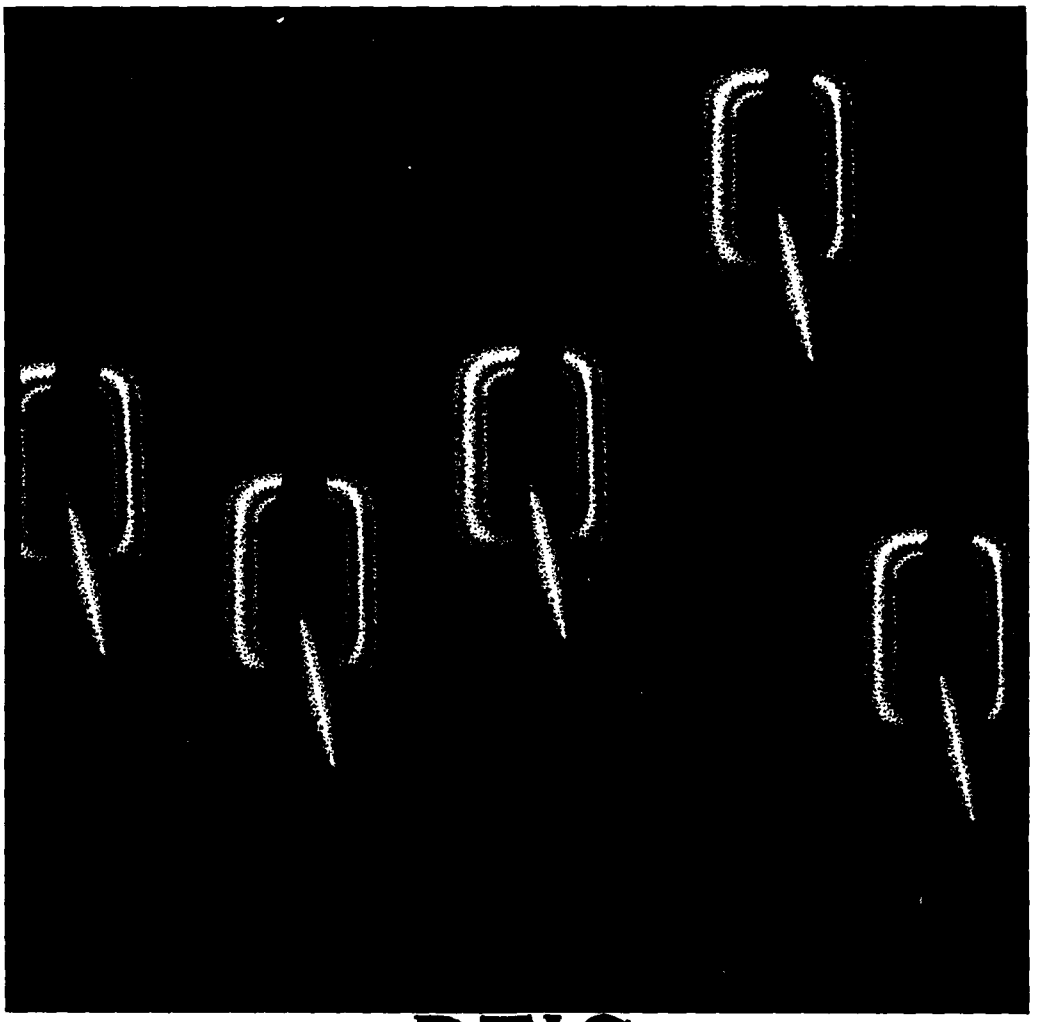

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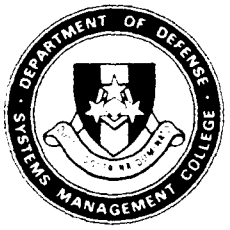

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Cover: Quality is the most important link to better program management.

Systems Management College

Also

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SYSTEMS ENGINEERING: THE KEY TO TQM

Roberts A. Meadows
Dr. Linda P. Beckerman
Dr. Chet Richards

FIGURE 1. SYSTEMS ENGINEERING METHODOLOGIES FOR TQM

Customer Needs Analysis
Functional Analysis
Requirements Allocation

On March 30, 1988, the Secretary of Defense signed the "Department of Defense Posture on Quality" memorandum and thereby initiated the DOD Total Quality Management (TQM) program. All defense agencies and programs, as DOD entities, fall within the purview of TQM.

This paper, however, looks at TQM from a different aspect. Although TQM is a philosophy and a never-ending process, each individual TQM effort or project is itself a program and should be run as such. These improvement programs must be a high priority for managers of weapon systems programs since improvements in company systems will better enable them to achieve performance, quality, cost, and schedule goals.

In particular, a TQM project can be a program to make sizable and, indeed, radical improvements in the way a DOD component or contractor does business. It can be done. For the curious, Schonberger lists some 86 examples of substantial improvements, mostly involving U.S. companies.[1] A DOD panel recently concluded that if the U.S. defense industry could become as efficient as the Japanese auto industry, we could have the high technology weapons we need within budgets that we could afford.[2]

The quality gurus claim an organization's management system causes 85-95 percent of its problems. If they are right, permanent and significant improvement in an organization's performance can only come from improvements to its basic systems. By system problems, we mean those that are not attributable to the failings of individual workers. As Deming points out, most workers are already doing as well as they can.[3] This suggests that improvement efforts based on exhortations to "do more better" within the current system are not likely to meet with much success.[4] Workers' resentment of attempts to simply order quality into existence may actually make things worse.

In fact, all of us have always known it's the system. Who has not, in explaining how to get things done, said things like "You have to work the system," "You have to work around the system," "You can't beat the system." What we didn't know, however, was what to do to change the system so we didn't have to "beat it."

The real work of TQM is to transform management systems—systems of vital interest and importance to every program manager. What we have done in Star Quality, our TQM process at Lockheed, is to develop effective methodologies for doing this. In this paper, we outline basic concepts and describe tools to apply them. We give examples from our pilot project, restructuring the LASC-Georgia mail distribution system, where we obtained improvements of more than 500 percent.

Methodologies For Restructuring Management Systems

Any attempt to change or improve a system must be based on a solid definition of what that system is really supposed to accomplish. Without this foundation, effort will be squandered in improving something that does not need to be done. Thus, the first step is to define basic system requirements, just as would be done when developing software packages or weapon systems.

Our approach for defining management system requirements is to use the same [illegible] systems engineering techniques that we use to define [illegible]nents for an aircraft, spacecraft or other complex sys[illegible] Our adaptation of these techniques for a company's organizations reflects the reality that organizations are human systems and that in these systems the human element predominates. This imposes some interesting psychological aspects onto the methodology.

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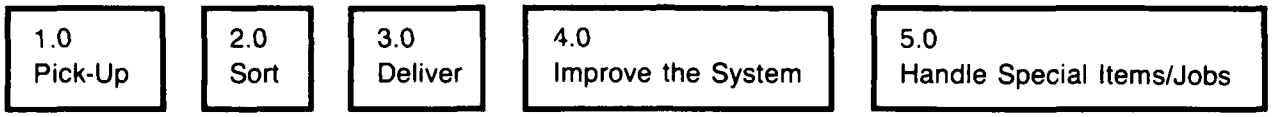
FIGURE 2. LASC-GEORGIA MAIL SYSTEM TOP-LEVEL FUNCTIONS



The Working Team

A critical precursor to application of the methodology is the selection of the working team. Experience taught us this must include owners of the system. This means all people responsible for making the system work; the entire hierarchy of managers, as well as the workers.

A graphic illustration of the psychology of human systems was demonstrated during training sessions. In these we introduced the concept of a system by stating a definition: "An interacting set of elements forming a unified whole in order to achieve a desired purpose." Then we showed a picture of a bowl of fruit and asked if this was a system. Half the people saw the bowl of fruit as a system and half did not.

In other words, a system is a concept in people's minds.[5] This suggests that owners of the system must be the ones defining what it is, what it is to accomplish, and what changes should be made to it. Outsiders, such as systems engineers or management consultants, will see it differently. If they attempt to impose changes, the people who must live with the system after they are gone will treat the improvement process as yet one more iteration of "beating the system."

Additionally, it is owners of the system who decide where to draw boundaries around the system that define where they will accomplish improvements. This activity recognizes that most company systems are a subsystem within a larger system. In truth, a defense contractor's company system is part of the overall defense system that includes DOD, the Congress, etc., and many TQM projects of the type described here will need to have DOD counterparts as participants.

Pilot Project

The pilot project, to improve the quality of Lockheed's Mail Distribution System, illustrates these points. All owners of the system participated and were committed to this effort. We began with managers and brought in the Union Shop Steward; we explained ground rules that no hourly employees would lose jobs because of this effort, nor could we ask for budget to improve the system. Improvements would be made with the people and resources already on hand. At this point, we brought the rest of the hourly employees onto the team.

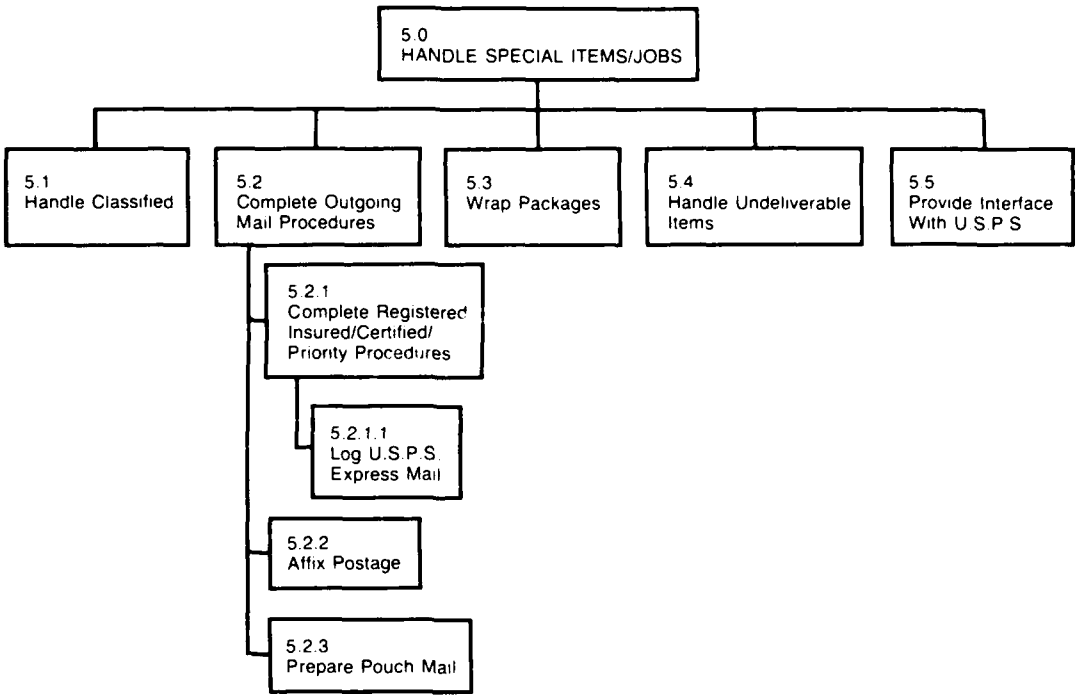
Once the team and system boundaries were selected we began to apply the first of the three systems engineering methodologies listed in Figure 1. This first step, a Customer Needs Analysis, was performed to determine the required output of the entire system. This consisted of an informal survey asking what customers wanted and needed the system to do for them.

Although we received many answers, there was a broad consensus that our employees needed to be able to depend, without fail, on next-day (24-hour) service for all intercompany mail. For mail going out of the plant, customers wanted it to go out the day it was mailed; for mail coming in, customers wanted to receive it the same day. They also wanted twice-a-day, scheduled, pickup and delivery.

Functional Analysis

After we established, and got the Lockheed community to agree to these overall system requirements we performed a Functional Analysis to answer the question: "What tasks or activities is the system supposed to carry out to meet those requirements?" We did this by meeting as a group every day for intensive one-hour brainstorming sessions. We initially identified four major functions, the ones shown as 1.0, 2.0, 3.0 and 5.0 in Figure 2. Then we identified subfunctions that had to be carried out to accomplish the higher-level function. We did this as a hierarchy, expressly to destroy any implied time sequencing, because we didn't want to get locked in to preconceived notions about how the system was supposed to operate.

FIGURE 3. A TYPICAL FUNCTIONAL HIERARCHY



We had these functional hierarchies drawn up on our inhouse computer-aided design system, CADAM, and updated daily. A typical example is shown in Figure 3. They were displayed on the walls of our meeting rooms as working charts for the team. This had the psychological benefits of making the mental process of identifying functions visible as well as reinforcing the notion that nothing was so holy that it couldn't be moved, deleted or added to. It gave everyone immediate feedback on the output of previous brainstorming sessions.

Challenge Everything

Then we went back through each function in the hierarchy and asked: "What is the purpose of this function? Why does it have to be done? What would happen if we just left it out?" Here, the idea was to get team members to challenge everything. This was the stage in which enormous gains were made in eliminating waste in the system. An example will illustrate the power of this step.

One of the tasks identified in the functional hierarchy required that any envelopes addressed to Accounts Payable be opened, any checks be taken out of the envelope and entered into a log and both log and checks be delivered immediately to Finance. When the team was asked why we were performing this function, we were told: "To provide a service." When asked why that service, we were told: "Because Finance wants us to." When we asked why Finance wanted this service performed, we found that we could not definitively answer this question ourselves and had to query our customer, Finance, directly. Finance's answer was: "We don't have a requirement for this service."

What we discovered about how this situation arose has important implications for all system improvement efforts. It turned out that this was an essential function when the system was established. In those days the company was receiving large payments through the mail and special accountability standards were warranted. However, with the advent of electronic transfer of funds, there was no need for special handling.

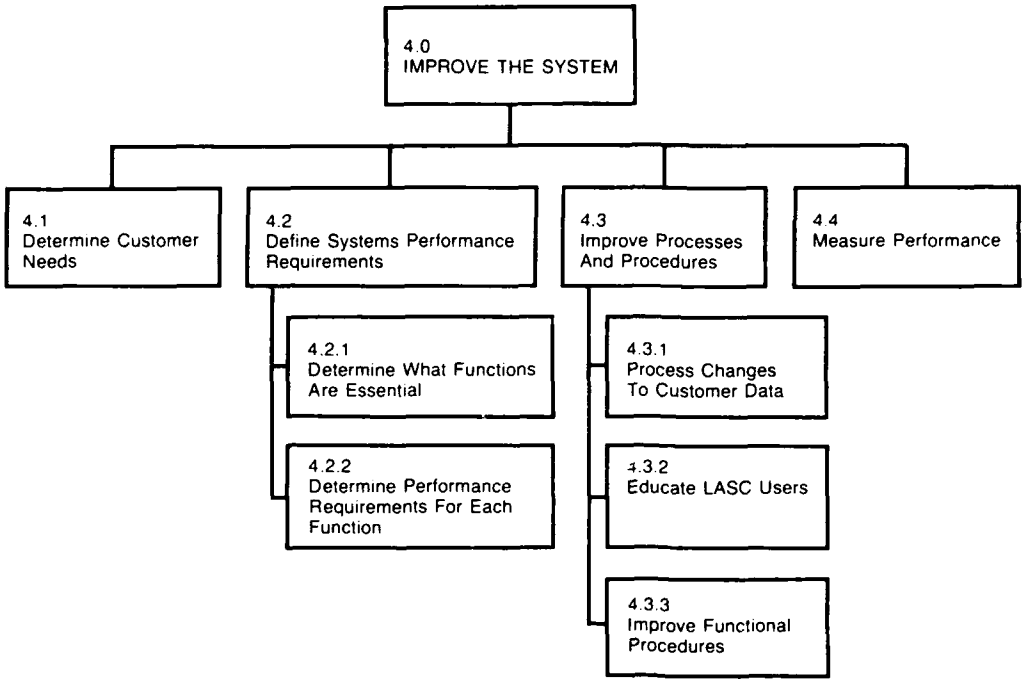
The system had no way of knowing this. For years it continued to carry out a function that consumed efforts of one employee working virtually full time (in a system that contained only 15 total). Wasted effort was expended that could be spent better meeting the current system needs. This inspired us to coin the phrase "vampire functions." These are functions that live on long after they should have been. What Systems Engineering does for TQM is to shine the light of day upon obsolescent functions.

What Is Valid?

Another critical addition we made at this time ensured non-essential functions did not continue. To this end, we added a top-level function, "Improve the System," as shown in Figure 4. This, in effect, gives the system consciousness, and provides subfunctions so that system owners (management) will determine regularly whether it is carrying out essential functions, and whether requirements of each are still valid. It is our belief that all organizational systems should contain a function of this type.

Having convinced ourselves we had identified each essential function, we progressed to the third methodology, Requirements Allocation, where we defined requirements for each remaining function. These requirements called out in specific terms what had to be done for each function to be carried out satisfactorily. This had the benefits

FIGURE 4. GIVING THE SYSTEM CONSCIOUSNESS



of removing waste due to ambiguity and establishing a basis for valid measurement.

For example, one of the functions of the system is to deliver mail that is initially undeliverable, usually because of insufficient address. Since we received about 1,000 such items from outside sources every week, finding out who each was intended for was extremely time-consuming, especially since the employees were making a conscientious effort to get these items delivered (remember all are already doing the best they can). To cope with the ambiguity of what to do with undeliverable mail, we defined a requirement specifying undeliverable bulk mail shall be destroyed. For first-class and other mail, we will spend up to 5 days trying to deliver it. Then it is returned to sender.

Document Everything

Requirements took the form of capabilities (carry 70 lb.), time dependencies (before 3 p.m. and within 24 hours), order of precedence (before another function), or any other way of describing whether the function has been performed adequately. The requirements we derived for handling undeliverable items are shown in Figure 5.

While this was going on we were documenting everything in a systems specification. We followed the format of Mil-Std 490 as closely as possible because it is immediately recognizable to people familiar with a system specification. This captured for us in black and white, at any moment during the process, what progress had been made so that the team could see the fruits of their effort. More importantly, it provided the final set of requirements that we could now hold up against the existing system and ask: "Is the system as it currently exists able to meet these requirements?"

The answer to this for the mail distribution was: "No." At this time, direct systems engineering assistance ended and owners of the system began to identify and implement changes to their processes so that they were able to meet system requirements. Owners of the system, especially hourly employees, are best qualified to create changes to their processes. On the mail system, these changes have been spectacular. Before they began, it often took from 4-7 days for an item of internal mail to get from one end of the hallway to the other. Today, the system often gets the mail there in the same day, beating the 24-hour requirement.

Interesting Lessons Learned

One of the more interesting lessons learned on this project was the importance of discovering "critical functions." These are high-leverage functions, where small improvements can produce very large payoffs. In the case of the mail-distribution system, the critical function was route delivery—the one that had the most bearing on the ability of the system to meet customer requirements. Anything that drew resources away from carrying out that function, even to carry out other essential functions, was a subtle vampire depleting the system. An example of such a "vampire" is a special delivery, which provides a higher level of service for critical offices. However, in the time required to make one special delivery, a mail clerk could serve several hundred employees on a route. As route performance improved to 1-day turnaround, we were able to eliminate the need for many special deliveries, thereby further improving route performance.

Another important lesson learned was how improvements to the system affected morale of owners of the system and how this, in turn, resulted in improvement beyond original expectations.

FIGURE 5. PERFORMANCE REQUIREMENTS FOR A TYPICAL FUNCTION

3.2.5.4 HANDLE UNDELIVERABLE ITEMS.

Delivery shall, for non-bulk mail, be to the last department of record. If still undeliverable, mail/items shall be returned to sender. Undeliverable bulk mail shall be destroyed. Items shall be dispositioned for delivery, return to sender, or destruction, as per requirements within 5 working days.

Culture Follows System

Anyone who has led a military unit will attest to the overriding importance of morale in human systems. Unlike those who insist that it be some type of mystical input required for superior performance, we have found that morale is actually one of the *results* of a successful system design effort. That is, culture follows system, not vice versa.[6]

With a redesigned system, mail distribution employees express their highly visible pride by regularly doing better than the system requirements demand and by comments like: "Hey man, we're smokin'." Before the system was redesigned, a typical savings bond drive participation was about 50 percent. Today, with the same group of employees, we get 100 percent.

Conclusions

It is possible to make the types of improvements we read about in Japan, but you cannot simply order them into existence. You will have to do the hard work of redesigning your organizational systems to eliminate waste. The techniques of systems engineering can play a key part in this process by helping to eliminate those activities—functions—that no longer serve to accomplish the organization's overall objectives. There is no need to improve a function you shouldn't be performing in the first place.

The end result is a simplification of the system that includes only essential functions and valid requirements, yet meets all performance requirements imposed by the "outside" world.

When you go through this process, and demonstrate to your employees that you are serious about attacking the 85-95 percent of the problem that falls under management's control, morale and the other human elements will improve. Results can be almost unbelievable. Increases of 300 percent in productivity and quality, and improvements in turnaround time on the order of 500 percent are not unknown. It will take this type of improvement to manufacture our new generation of weapon systems at costs that we can afford.

Endnotes

1. Richard Schonberger, *World Class Manufacturing: The Lessons of Simplicity Applied* (New York: The Free Press, 1986) pp. 229-236.

2. United States Department of Defense, "Findings of the U.S. Department of Defense Technology Assessment Team on Japanese Manufacturing Technology" (Washington, D.C., November 1988).

3. This point is made by W. Edwards Deming in seminars and classes. It is a persistent theme in his book, *Out of the Crisis* (Cambridge, Mass.,: The Massachusetts Institute of Technology, 1986), and is emphasized in the section on "Barriers that Rob People of Pride in Workmanship," pp. 77-85.

4. Kenichi Ohmae, "Companyism and Do More Better," *Harvard Business Review*, January-February 1989, pp. 125-132. This is also Demings' Principle 10, "Eliminate Slogans, Exhortations, and Targets for the Work Force." (Deming, *op. cit*, pp. 65-70.)

5. In other words, how you view the system may greatly affect the results you get. An excellent discussion of the implications of this statement is found in the chapter on "Thinking" in C. West Churchman's *The Systems Approach*, (New York: Dell Publishing, 1968).

6. Deming estimates that "barriers against realization of pride of workmanship" are one of the greatest causes of cost and quality problems in the U.S. (*op. cit.*, p. 83). Note that barriers are part of the system, and pride is an aspect of culture.

PROGRAM MANAGEMENT THE AIR FORCE WAY

James Gill
Robert Bemben

DISCLAIMER: The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

In its final report to the President, the Blue Ribbon Commission on Defense Management concluded that "The entire undertaking for our nation's defense requires more and better long-range planning" and "to accomplish meaningful long-range defense planning, certain modifications are needed in our defense establishment."[1] As the United States reaches the decade of the '90s, these statements assume added significance as shrinking resources muddy the waters of strategic modernization.

Increased fiscal constraints, however, are just one of the many obstacles strategic defense planners must overcome in formulating force development policy. Examples of other problem areas include the changing threat environment, arms control initiatives, and the rapid pace of technological change. In this rapidly changing environment, how does the military ensure that its planning is consistent with these concerns?

Planning long-term[2] defense needs begins with a threat assessment and identification of mission requirements in order that a force structure may be designed to counter the adversary's capabilities. Threat assessment is the first major hurdle that planners encounter. Through a variety of means, data regarding the Soviet threat is gathered and evaluated by the intelligence community. There are two major difficulties with intelligence collection—the reliability of the data itself and, even if the data is factual, the interpretation of the data.

A large part of the problem is created by the planner's interest in what the enemy will be doing sometime in the future, not what he is doing now. While some experts feel that intelligence can see 5-10 years into the future, others are less optimistic. As one retired Air Force general put it, "Realistically, we can see three to five years in the future...."[3] In many cases, then, the strategic planner must structure forces for a threat that is only partially understood.

With the long lead times required for acquisition of strategic systems, this may lead to fielding a weapon system that is inappropriate or ineffective due to changes to the threat. This is an especially critical problem in a time of budgetary limitations.

A Key Problem

A key problem for the planning staff is managing change in the resources available to achieve the desired force structure. The defense budget is subject to wide cyclical swings as national priorities change. This is particularly true today as we have seen defense spending move from a real growth rate of 12 percent in fiscal year (FY) 1982 to the zero growth being proposed for FY 1990. With burgeoning federal deficits, these fiscal constraints on defense spending are likely to increase rather than decrease into the forseeable future. This causes several problems for planning.

As was witnessed with the B1 bomber program, starts and stops in production of systems contribute to significant cost growth. This is due not only to the inefficiencies of production but to the inflation that occurs in the interim. The old rule "you better buy it now before the price goes up" is useful advice here. While defense managers are attempting to circumvent this problem through a more judicious utilization of multiyear contracting, this approach does little to prevent the delay of systems that are currently assigned targets by strategic planners.

A major problem that arises in cancellation or stretching out of programs is the discontinuity between the missions planned for specific weapons and the actual capabilities if those forces are not fielded. If a new reentry vechicle has been identified as required for coverage of a specific target set and that program or some other with its capabilities is not funded, how is that target set allocated to the remaining system?

At the very least, a reevaluation of targeting priorities must take place and, at worst, coverage of certain targets may have to be deleted. It has been alleged that all too often, the revised capabilities are not reflected in the targeting priorities.

Another consideration in force deployment decisions is the potential impact of arms control agreements. A case in point is the current political pressure for a START agreement that would drastically reduce the numbers of warheads available to each side. This type of agreement would reward the side that had increased the number of aim points by fielding systems with smaller numbers of warheads. The United States, however, has fielded 50 ten-warhead Peacekeeper missiles, along with the Trident D-5 which has the capability of carrying up to 14 warheads. This assessment is meant to emphasize the need for flexibility and adaptability in planning force structures.

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Political Constraints

The planner must also deal with political constraints imposed from a variety of sources. The Project on Monitoring Defense Reorganization has indicated that there is an overlap in responsibility of the congressional committees on Budget, Appropriations and Armed Services, all of whom share oversight of the Pentagon's budget.

While the report indicated that this type of micromanagement was responsible for some of the problems with the acquisition system, it indicated that none of the panels was likely to relinquish its charter. Given the pluralistic nature of our society, this haphazard management style is unlikely to change; but it is another factor planners must deal with and, again, emphasizes the need for a greater degree of flexibility within the acquisition system.

This is but a small illustration of the problems that strategic planners face but they provide a background of some of the more important ones. Several of these obstacles could be removed or minimized by legal or departmental actions. Others, such as changes to the threat cannot be impacted by U.S. actions. In all cases, the planner must deal with them in designing a strategic force structure that will maximize U.S. capabilities. One of the more innovative approaches to reconciling these problems is found in the Air Force Minuteman Long Range Planning (MLRP) Group.

In recognition of many of the difficulties cited above, the MLRP concept was developed by representatives from the Strategic Air Command (SAC), the Air Force Systems Command (AFSC), and the Air Force Logistics Command (AFLC) in 1985. Their proposal to the HQ USAF recommended a long-range, integrated planning approach to Minuteman life extension.

At the same time, they proposed that this approach eventually encompass all ICBM systems. The USAF agreed to the concept. The Peacekeeper system will soon be added and the group will become the ICBM Long Range Planning Group.

The Organization

The MLRP organization is headed by an Executive Committee comprising General Officers from Ogden Air Logistics Center (OO-ALC), the Ballistic Systems Division (BSD), and SAC. This committee meets at least once every two years in coordination with the Program Objectives Memorandum (POM) cycle.[4]

In addition to the Executive Committee, a Steering Group meets yearly, a Systems Panel meets semiannually, and three Working Groups meet more frequently. The organization of the MLRP was designed with several goals in mind.

First, it was believed that approval of the Executive Committee would add significant credibility to proposals presented during the POM process.

Second, previous methods of requirements generation had led to a less than optimum communication between the user and the buyer, be that AFSC or AFLC. A forum was needed where the user could articulate requirements, and the buyer could provide options to meet these requirements.

Although there are differences in membership on the Systems Panel and Working Groups, there is a core of people from all three commands who attend all meetings. By involving key people early in the decision process, a closer working relationship between commands is developed.

Finally, the three Working Groups are structured along functional lines to provide the necessary expertise in each area.

To understand the workings and decision processes of the MLRP, it is helpful to examine the documents generated by the MLRP.

PROGRAM MANAGER'S NOTEBOOK 1989

There's good news and there's bad news!

The good news is that there is a 1989 edition of the *Program Manager's Notebook* fact sheets. The bad news is that acquiring a copy requires a written request.

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Robert W. Ball

The Program Management Plan (PMP) serves as the charter of the group. It delineates the planning approach, the organization of the group, responsibilities of the three commands and the panel and working groups, and a plan of execution of the MLRP. There are also periodic PMP Annexes which update the PMP as required.

Mission Objectives

The three functional Working Groups are separated into the areas of mission objectives, logistics requirements, and system options. The mission objectives group is chaired by the HQ SAC ICBM Requirements Directorate. This group has been assigned the task of identifying mission objectives for the next 20 years. Their starting point is an analysis of the threat. As was discussed earlier, this analysis is subject to a large amount of uncertainty. However, size of the group and its frequent meetings permit faster changes to threat assessments than are typically possible in the larger arena of National Intelligence Estimates.

The working relationship among the user (SAC), the system designer (BSD) and current system program manager (00-ALC)[6] also allows the MLRP to translate these changes into hardware in a much more efficient manner. In addition to threat assessment, the mission objectives group is responsible for forecasting future ICBM force structures. This requires them to make assumptions regarding the potential ICBM force mix among Minuteman II and III, Peacekeeper, Rail Garrision, and/or the Small ICBM.

As part of this process, contingency planning is accomplished that addresses the possibilities of one or more systems being delayed or cancelled. Force application for the Minuteman weapon system is also outlined by this group. The threat assessment force structure projections, and force application are included in the Mission Objective Report. This document is published semiannually.

The Mission Objectives Report is then reviewed by the Logistics Working Group, which is chaired by 00-ALC, to determine logistics support requirements for the next 20 years. A supportability assessment is conducted which entails an examination of availability of spares and replacement parts, reliability studies, maintainability, and capability.

Integrated logistics program planning is accomplished at this point with a view to establishing logistics support effectiveness, cost, and schedule requirements. Like the Mission Objectives Group, the Logistics Group then presents findings in a Logistics Requirements Report.

Available Options

The System Options Group is chaired by the BSD. With mission and logistics requirements in hand, this group examines available options to implement system enhancements that will meet the mission objectives and logistics requirements. These changes could involve any component of the weapon system such as the missile itself, facilities, command, control, and communications (C^3), operational ground equipment, or maintenance support equipment.

These may be further broken down into major subsystems of the missile such as propulsion, guidance and control, or reentry vehicles and components of the facilities like the launch facility itself or the launch control facility. After examining all available options, the System Options Group formulates a System Options Report outlining the most feasible alternatives.

The documents prepared by the three working groups are then assembled into a Twenty-Year Technical Plan (TYTP). Contents of this document are illustrated in Figure 1.[5] After approval by the Executive Committee, this becomes the current Minuteman master management plan for the next 20 years and, like the PMP, periodic updates are developed as required.

After approval by members of the Executive Committee, these recommendations are presented as part of the POM process. If funding for implementation is authorized, the process will continue with System Requirements Analysis (SRA), conduct of tradeoff studies, and development of specifications for contractual action. A major program identified by the MLRP to receive funding was the Minuteman Rapid Execution and Combat Targeting (REACT) program.[7]

Successful Program

Starting with feasibility studies in 1956, the Minuteman I reached initial operational capability (IOC) 6 years later in 1962. Almost immediately, improvements to guidance and launch control centers were developed and implemented in the Minuteman II which was first fielded in 1966. Finally, MIRV technology and additional guidance improvements were added to the Minuteman III which became operational in 1970.

The Minuteman system's design requirements were based on a 3-year life with a design goal of 10 years. Notwithstanding these expectations, some Minuteman IIs have been operating for more than 20 years and have exceeded readiness specification requirements. Because of this extension, continual modifications have been made to the system to upgrade its capabilities and extend its useful life.

These modifications have included improved hardening, silo upgrades, introduction of the Mark 12A warhead, and addition of the command data buffer for faster retargeting. In addition, guidance improvements are under review for possible implementation and a washout and repair of the State II and motor propulsion program should be completed by the early '90s.

FIGURE 1. MINUTEMAN LONG RANGE PLAN DOCUMENTATION

20-YEAR TECHNICAL PLAN

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Despite its productive service life and its improved capabilities, however, there are concerns with the Minuteman system. The Minuteman represents 10-20 year-old technology. Potential improvements had been identified by the three separate commands before formation of the planning group. A requirement for computer-aided message processing (CAMP) was being studied by the BSD while SAC had generated a requirement for faster retargeting capabilities.

Both improvements were designed to improve SAC warfighting capabilities, particularly with regard to the Soviet deployment of mobile missiles. In order to attack these relocatable targets, the ICBM force requires expedited processing of emergency war orders (EWO) as well as a rapid retargeting capability.

Working Conditions

At the same time, SAC realized that the numerous modifications and communications additions to the launch control center (LCC) have resulted in difficult working conditions for the launch crew. These crews were required to work in a highly stressed environment with multiple messages and alarms resulting from myriad independent systems they are required to monitor and operate. The tri-command MLRP Group determined it was necessary to integrate the various LCC add-ons and modifications.

In studying these three programs already being proposed, the MLRP discovered that the three improvements impacted each other and REACT was developed to integrate all three modifications at the same time. This approach offered several advantages.

By combining all three requirements into one program, duplication of effort was eliminated. In addition, the three changes involved responsibilities of two different AFSC Product Divisions—the BSD and the Electronics Systems Division (ESD). Under a single program approach, the responsibilities were delineated in a Memorandum of Understanding between the two offices, again eliminating duplication of effort and resulting in a substantial cost savings.

More Efficiency

When completed, the REACT program will permit the launch control centers to stay on alert beyond the turn of the century, incorporate new functions, and provide for streamlined EWO operations. Integration of LCC functions will provide for more efficient two-crewmember operation and a workable one-crewmember operation, except for launch and enable functions. It will improve logistics supportability and provide for growth capability by providing commonality among different systems required for deployment of either the Rail Garrison or Small ICBM systems.

The MLRP concept is certainly not the solution to all the obstacles defense planners face but it does alleviate several of them. In the area of threat assessment, changes to existing systems can be implemented in a more timely manner and at less cost than previous methods of incremental improvements. While this concept is not novel to the ICBM program (in fact AFLC has utilized this concept on a number of other strategic programs) it is one example of the successful quality management approach to weapon system acquisition.

In the area of shrinking resources, better planning is an absolute necessity. It is a hard fact that requirements and missions are often dictated more by budgets and costs than by national security requirements. As has been mentioned, learning to do more with less will become essential for our strategic forces to maintain their deterrent capability. The MLRP provides the long-term outlook, tempered by adaptability to change, that is required by fluctuations in resource availability.

Coordination

Although the MLRP, as currently structured, cannot impact on the forces of inter-service rivalry, it has accomplished a great deal in ameliorating intra-service conflicts. Planning mission needs and requirements together fosters a better working relationship among different USAF commands and offices. By developing a roadmap for system operation over its entire life cycle, competing command requirements can be coordinated, resulting in improved performance at less cost.

Finally, the MLRP's greatest asset is flexibility. By planning at the systems level, requirements can be changed and adapted more quickly due to support of program managers at all three commands. With their involvement, and that of the Executive Committee, favorable reactions to resulting recommendations are more likely.

The MLRP appears to be a concept with great potential for improving existing capabilities at minimum cost. If fiscal constraints on defense spending continue to increase, it may represent one of the few methods available to the USAF to improve its deterrent capabilities while remaining within budget.

Although some may criticize this represents "deterrence on the economy plan," it is undeniable that requirements are increasing while available options are decreasing.

Funding

While ICBM programs seem to have the greatest problems in securing funding, as concerns strategic systems, it is likely that the Navy will soon be facing similar difficulties. If so, this concept for long-range planning at the system level should be closely evaluated for possible use by the Navy in maintaining their portion of the strategic triad.

Perhaps a more revolutionary possibility would be the creation of a Joint Strategic TRIAD Planning Group to incorporate, at the working level, the potential contingencies for strategic options.

Thus, the bomber and missile working groups would structure their plans to agree with those of the SLBM working group. This form of multiservice cooperation is totally in accord with the Defense Reorganization Act of 1986 and the National Security Decision Directive (NSDD) 219 which advocated the consolidation of Service responsibilities.

"The Defense Reorganization Act and NSDD 219 have provided the OJCS with the means to help reduce these sources of instability so that program managers can concentrate on the internal elements of their programs a little more and the externals a little less. During the coming years, program managers can expect to see more sister-Service uniforms in the meeting room, more joint funding initiatives, and less tolerance for the discovery of disjointed efforts".[8]

In summary, the MLRP concept offers few, if any, disadvantages and much to recommend it. Its true effectiveness, however, can only be judged by time and the results it is able to achieve in the challenging years to come.

Endnotes

1. *A Quest for Excellence*, Final Report of the President's Blue Ribbon Commission on Defense Management (June 1986), xvii.

2. Long-term planning, as used in this paper, refers to a period beyond the next budget year. The MLRP uses time periods of 5, 10, 15, and 20 years for planning purposes.

3. Retired Brigadier General Gerald Schwankl, as quoted in "The Price for Might," *IEEE Spectrum* 25, No. 12 (1988), 41.

4. The POM is an integral part of the Planning, Programming, and Budgeting System (PPBS) which is the cornerstone of the Defense budgeting process. The POM represents each Service's requirements to be added to the Five Year Defense Plan (FYDP). An excellent explanation of the PPBS process can be found in *The Planning, Programming and Budgeting System (PPBS)--A Primer*, (Washington D.C.: U.S. Air Force, 1981.)

5. Figure 1 is a chart used in briefing the original MLRP concept to the Air Staff.

6. The Ogden Air Logistics Center, as the Minuteman system program manager, is responsible for the support of this deployed system.

7. The REACT program mentioned here is only a minor portion of the total MLRP.

8. *Program Manager*, July-August 1988, Lt Col Christopher Wain, USAF.

ARE YOU COMMUNICATING EFFECTIVELY?

David D. Acker

Effective communication involves a good exchange of thoughts, concepts, ideas or opinions between one person, or one group, and another. It involves sharing information and, at times, expressing emotions. In business and industry, three important communication processes occur, namely, gathering information with which to make decisions, passing on the decisions, and changing attitudes.

Effectively communicating may require planning, patience, and skillful execution. According to George Vardaman, "Effective communication is purposive symbolic interchange resulting in a workable understanding and agreement between the sender and the receiver."[1] Today, the successful manager or professional person can meld the message into an effective presentation for achieving desired results.

Importance of Effective Communication

Let's turn attention to the importance of communication to management success. The need to communicate clearly has been recognized by notable people like Henri Fayol, French mining engineer, who included "unity of direction" among his seven management principles.[2] Charles Bernard, author of *The Functions of the Executive*, felt that maintenance of (effective) organizational communication was one of the basic executive functions.[3] Indeed, effective communication may be the essence of organizational activity.

The growth of interest in effective communication by management in the last century may be attributed to the following:

—Increase in the size of domestic companies and growth of international companies.

—Specialization of occupations and increased need for cooperation between them.

—Growth of national communication networks; i.e., telephone, radio, television, satellites, computer networks, fax machines and others.

—Increase in occupational mobility, meaning new employees must "learn the ropes" quickly.

—Belief that above changes and trends are likely to continue.

One reason for growing, widespread interest in effective communications is because our communications have not been as effective as they should be. Why? There has been:

—Frustration at all managerial levels because of lack of clearly defined responsibilities, and

—Lack of clear communications up and down the organizational ladder.

Broadly speaking, for every difficulty encountered within a modern-day organization, there seems to be some kind of insufficient, distorted, or poorly planned or timed exchange of information. Most of us recognize that communications problems have become one of the most frequent causes and effects of administrative or operational failures.

Even in top management, these problems occur. According to Maier, communication gaps among managers often are wider than within the more routine positions they control.[4] An examination of four companies revealed communications failures are an everyday occurrence, at all organization levels. It is interesting that failures are not confined to periods when major organizational changes are taking place.

Someone made the observation that the more education the subordinate has, the more accurate communication tends to be with management. Similarly, the more feedback involved between a managerial pair, the better listening ability of the superior, and the higher the managerial style of the subjects, the more effective the communication.

According to Peter F. Drucker, "Managing requires special efforts not only to establish common directions, but to eliminate misdirection. Mutual understanding can never be attained by 'communications down,' solely by talking. It results too from 'communications up.' It requires both the supervisor's willingness to listen and a tool designed to make employees heard."[5]

Number of Links in Process

Distance, in terms of the number of links (people) in the communication process from sender to final receiver, is a major cause of breakdown. For example, rumors become more inaccurate as links increase. Each link tends to add distortion.

Drucker states "Every additional administrative level makes the attainment of common direction and mutual understanding more difficult. Every additional level distorts objectives and misdirects attention. Every link in the chain sets up additional stresses, and creates one more source of inertia, friction, and slack."[6]

Many companies in recent years have reduced the number of levels in their organizations. The least number of links might be called, "the man, the manager, the management organization." Top executives have the greatest amount of decision-making power. Therefore, they have the greatest need for information that is correct and reliable. If information in the information channel gets heavy or clogged, management has less time to consider and digest it. The manager may have to be briefed by an assistant(s) and, as a result, the manager may become insulated from the true facts of what is going on. Most managers, of course, like to think there is a pyramid of communication centered beneath them. In fact, there may be a labyrinth of communication barriers below them.

Speed of Process

Speed of information diffusion is an interesting study. It is effected by size of the organization, potency of the information (information of great interest travels faster), time for transmission (diffusion rates rise quickly and slow down gradually), space factor (physical proximity to the source of information is the strongest factor in determining whether a particular person receives the message), and stimulation factor (it takes a great increase in the initial input of information to get a small increase in diffusion of the information).[7]

Some researchers found that speed and accuracy in communication are complementary. The Duke of Wellington told his commanders to "do the business of the day in the day."

Frequency of Process

There is a direct association between frequency of communication and good leadership behavior. A person communicating with another receives recognition and a sense of well-being is enhanced.[8]

If there is a high wall or closed door between a subordinate and a manager, the subordinate's well-being is affected. This has been an argument in favor of open office and factory areas. There have been complaints about open areas. Some feel such conditions permit too much communication, disturbing people on the fringes trying to carry out assignments efficiently.

Quantities of official communication do not help solve management or organization problems. Communication improvement programs often prove ineffective because they overload formal communication channels. Effective functioning of the organization and the communication process depends on an optimum exchange of information. When a task is delegated to an administrative assistant, the assistant becomes insulated to some extent from certain aspects of the task assigned; he not only becomes insulated, but needs to be. Barriers to communication are sometimes necessary to get the job done. In an organization, some channel(s) must be kept open for the flow of crucial, available information.

Many managers find that of all activities they are required to carry on, verbal interaction is the number one form of contact. These managers believe that such contact may consume as much as 80 percent of their time. In a study conducted many years ago by Thomas Burns, it was found that as the management time spent in oral communication dropped from 80 percent to 42 percent, lateral communication with colleagues (in the upper percentages) changed to vertical communication.[9] Further, success in communication decreased as the direction changed.

Middle managers in formal organizations tend to overestimate frequency of personal contact with subordinates. Conversely, these managers often feel their most difficult communication problem is getting sufficient time or attention from their immediate superior. For good reasons, they have a desire for adequate and successful communication with their superiors.

Promotionally minded subordinates tend to restrict communicaton to their superiors, perhaps in an effort to maximize positive aspects of their success in assignments. Subordinates distrusting their superiors tend to restrict communication with their superiors, generallly feeling superiors may use information against them.

Communication Media

The main media for communication tend to be the same inside or outside the organization, such as speaking, writing, reading, and appearance. To be successful, the transmitted message and the received message must match as closely as possible. Failures occur in the "coding" and "decoding" process.

Most of us expect language to transmit messages accurately, and without help from within the organization. Most of us believe it is beneficial to document organizational (company) terminology. However, some people believe management should guard against undue reliance on the written word because it may become a substitute for face-to-face communication and, as such, lose its effectiveness.

More than one medium may be used at the same time. The media used may reinforce one another or they may contradict one another. Most of us find it difficult to reconcile conflicting signals, particularly if they involve gestures and appearance. For example, if actions are used as the means of communication, and the actions don't fit the statements made, communication problems arise.

Most research on communication media have been focused on problems of oral and written messages. Let's con-

sider employee handbooks and position/job descriptions. In most organizations there is usually low reader interest in handbooks and published position/job descriptions. Details of work to be done do not necessarily reflect the degree of agreement between the manager and subordinate on the details of the work assigned.

"In-house" publications, like company magazines or newsletters, and periodic newspapers are often used as basic presentational media. Sometimes the house organ is used by management as its principal means of communication with employees.

House organs are interesting to readers when style is informal. Employees will usually obtain information from organizational contacts when the house organ is stiff, precise or filled with jargon.

On the other hand, difficulties arise when informal, spoken communications convey messages in-house. Vital pieces of information may be committed to memory but details may become blurred. An effective manager ensures that important information is committed to writing, but still speaks to subordinates more often than using memoranda or guides to action. Before a decision is made about the communication to use, a good manager considers comprehensibility of the message to be delivered.

In the final analyses, the human medium is the most important communication medium. When a manager recognizes he is the communication carrier, this knowledge can be helpful in developing the perspective needed to maximize a communication capability. The manager, to be an effective communicator, must develop a proper attitude and outlook; personal communication confidence; ability to use language, voice, and body when orally communicating orders and ideas; clear and precise statement of purpose when writing a message; and an ability to recognize and handle needs and feelings of the message receiver, regardless of the communication medium he employed.

Closing Thoughts

I have briefly examined the role of communication in exchanging thoughts and concepts and its importance to management. I focused on benefits and problems associated with the various communication methods. One thing every manager should undertand is expressed well in the following quotation: "The manager's willingness to be accessible to subordinates and to attend to what is said plays a part not only as a direct link in the communications process but also as an example to others. Effective managers are typically regarded by their subordinates as being informed, open in communication, accessible, and receptive. They have personal skills in communication and give a great deal of time and attention to the communication process among their associates."[10]

Remember that communication is *always* a two-way process. At the outset, the communication sender must attempt to identify the receiver, and recognize the receiver will identify him through the communication.

The effective manager sends clear, concise, accurate and undistorted messages; further, learns to be a good message receiver and "tunes-in" to non-verbal messages and oral and written messages. Lunchtime discussions by subordinates of such a manager don't lead to the question: "I wonder what the boss really meant when he said...?"

What kind of message did you receive from reading this article? Do you have a better understanding of the importance of effective communication? Have you really been communicating effectively, or do you need to make changes in your approach?

Endnotes

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10. F. Mann and J. Dent, *Appraisals of Supervisors*, Institute for Social Research, University of Michigan, Ann Arbor, 1954.

Professor Acker is a senior member of the research staff, Department of Research and Information, Defense Systems Management College. Much of the material in this article will be added to the second edition of his widely acclaimed book Skill in Communication: A Vital Element in Effective Management planned for publication in 1990.

DSMC PUBLICATIONS: AN AVAILABILITY REPORT

Questions concerning the availability of Defense Systems Management College publications are daily fare for the Publications Directorate. This article is a status/availability report.

The College has 28 handbooks and guides available through the DSMC Publications Directorate, the U.S. Government Printing Office (GPO), the Defense Technical Information Center (DTIC) and the National Technical Information Service (NTIS). The College provides limited copies of these books to students, faculty, program offices, other branches of the government and to individuals in the government. Commercial requests are referred to GPO, DTIC or NTIS. The GPO sells 15 DSMC publications and is expected to add 4 more to that list in 1990. Copy made from microfiche is available through DTIC and NTIS. Defense contractors and government agencies can buy from DTIC. The same copy, using the same reference number, is available to the general public from NTIS. The GPO copies are perfect-bind publications suitable for bookcase and desktop display.

The following list provides titles and GPO and DTIC stock numbers. The GPO price is included. Costs of documents ordered from DTIC and NTIS depend on whether you order all or part of the document. Naturally, one chapter from the *Defense Manufacturing Management Guide* will cost less than the entire book.

A Program Office Guide to Management of Technology Transfer - DTIC/NTIS Stock No. ADA 214 265

Acquisition Strategy Guide - 1984 DTIC/NTIS Stock No. ADA 148 423 (NOTE: This guide is being updated. We expect it will be available at each of the above agencies by late spring 1990.)

Congressional Involvement and Relations - DTIC/NTIS Stock No. ADA 214 408

Cost Realism - DTIC/NTIS Stock No. ADA 214 266 (This book will be considered by GPO when it is updated in late 1990 or early 1991.)

Defense Manufacturing Management Guide - DTIC/NTIS Stock No. ADA 214 341 - GPO Stock No. 008-020- 01169-0, $17.00

Designing Defense Systems - DTIC/NTIS Stock No. ADA 192 007 (NOTE: A revised version of this book is scheduled for early 1990. The new title will be *Designing Quality into Defense Systems*. We will publish availability information in a later issue of *Program Manager*.)

Establishing Competitive Production Sources - DTIC/NTIS Stock No. ADA 146 006 - GPO Stock No. 008-020-01037-5, $13.00

Evolutionary Acquisition an Alternative Strategy for Acquiring C2 Systems - DTIC/NTIS Stock No. ADA 190 509

Glossary of Defense Acquisition Acronyms and Terms - GPO Stock No. 008-020-01187-8 (This is a revision and should be in all systems by mid-January 1990. We did not have a GPO price or a DTIC/NTIS Stock No. at press time.)

Guide for the Management of Multinational Programs - DTIC/NTIS Stock No. ADA 191 433 - GPO Stock No. 008-020-01129-1, $25.00

Integrated Logistics Support Guide - DTIC/NTIS Stock No. ADA 192 008 - GPO Stock No. 008-020-01081-2, $10.00 (Update due in late summer or early fall 1990.)

Integrating Industrial Preparedness into the Acquisition Process - DTIC/NTIS Stock No. ADA 214 343 - GPO Stock No. 008-020-01165-7, $10.00

Introduction to Defense Acquisition Management - DTIC/NTIS Stock No. ADA 209 388 - GPO Stock No. 008-020-01168-1, $2.50

Joint Logistics Commander's Guide for the Management of Joint Service Programs - DTIC/NTIS Stock No. ADA 189 225

Managing Quality and Productivity in Aerospace and Defense - GPO Stock No. 008-020-01179-7, $15.00 (DTIC/NTIS Stock No. not available at press time.)

Mission Critical Computer Resources Management Guide - GPO Stock No. 008-020-01152-6, $11.00 (DTIC/NTIS Stock No. not available at press time.)

Risk Management Concepts and Guidance - DTIC/NTIS Stock No. ADA 214 342 - GPO Stock No. 008-020-01164-9, $13.00

Scheduling Guide for Program Managers - DTIC/NTIS Stock No. ADA 192 011 - GPO Stock No. 008-020-01130-4, $3.25 (An update of this publication will be available in early 1990.)

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Test and Evaluation Management Guide - DTIC/NTIS Stock No. ADA (not available at press time.) - GPO Stock No. 008-020-01135-5, $15.00

The Program Manager's Notebook - DTIC/NTIS Stock No. ADA 214 338 - GPO Stock No. 008-020-01188-6, $24.00 (NOTE: Will not be available at GPO until around Jan. 20, 1990.)

Warranty Handbook - DTIC/NTIS Stock No. ADA 170 448

The following books are available only through DTIC/NTIS.

Proceedings, 1989 Acquisition Research Symposium - ADA 214 344

(See DSMC PUBLICATIONS, page 18)

EXPOSED:

THE REAL TRUTH ABOUT ESTIMATING ECONOMIC EFFECTS OF COMPETITION

Michael N. Beltramo

About three decades ago Secretary of Defense Robert McNamara endorsed the cost-saving attributes of competition in defense procurement. He set a standard of 25 percent for expected savings. A large body of research has since attempted to confirm or contradict his dictum. Many estimates of added costs or savings due to competition have resulted. Those estimates result from *a posteriori* assessments about what an item would have cost without competition.

This paper identifies and discusses analytical methods used to evaluate the economic effects of production competition. It does not promote one over another. Rather, it shows that all methodologies have serious deficiencies. Therefore, conclusions about the economic effects of competition must be carefully drawn and case sensitive in nature.

What Are We Trying To Do?

Most competitive programs have followed a period of sole-source production. Many have been analyzed to determine the economic effects of competition. Several methodologies have been employed for this purpose but most follow similar steps. They are:

—Obtain historical cost data including non-recurring costs to establish competition, initial (sole) source recurring production costs, and competitive production costs for both sources.

—Estimate sole-source cost for the competed quantity.

—Compare actual competitive cost (including non-recurring and marginal recurring costs) with the hypothetical sole-source cost.

—Determine effect of competition on procurement cost.

However, they differ regarding methods used to estimate the sole-source cost and the explicit and implicit assumptions they incorporate. In addition, there are often discrepancies and uncertainties about the content and nature of the available data. Both of these issues are discussed below.

Problems with Non-recurring Cost Data and Their Treatment

Problems with available data cut across all analytical methodologies. Furthermore, they underscore differences between a competitive environment (including one where competition is threatened) and a sole-source atmosphere.

Industry often allocates non-recurring costs to establish a second source. These costs are expended for: technology transfer, additional tooling and test equipment required by the second source, and educational units produced to qualify the second source. In addition, the government generally needs additional staff to oversee establishment of a second source.

Identification of all non-recurring costs would seem to be a straightforward task. But that is not the case. Government does not record and track its costs related to selecting, qualifying, and managing a second source. Furthermore, the initial source often receives additional contract awards to assist with engineering problems experienced by the second source after competition has begun. Failure to identify these expenditures understates non-recurring costs.

This raises the important issue of the difference in content between sole source and competitive production contracts. Sole-source production contracts normally include funds for related engineering and technical support services and for required hardware items. These additional costs are often reflected in the sole-source baseline but are missing from competitive contracts.[1] Thus, an apples and oranges problem exists when extrapolating a sole-source contract cost that includes services in addition to hardware and comparing the result to competitive contracts for hardware only.

Claims against the government filed and won by disgruntled second sources are another non-recurring cost element. In effect, some means of implementing competition have provided second sources with an insurance policy. Specifically, second sources may recover overruns caused by optimistic fixed-price bids by blaming an allegedly defective technical data package. There is no systematic procedure for tracking and recording claims. But they are a non-recurring cost of competition.

Data are subject to different interpretations. For example, the lot at which competition began may be an issue. There is disagreement about whether competition for the Sparrow AIM-7F Missile began at Lot 3 or Lot 5 (i.e., whether it began when Raytheon—the initial source—expected it to or when General Dynamics actually bid for a competitive quantity). The Lot 3 assumption indicates an estimated savings while the Lot 5 assumption shows a higher cost as a result of competition.

In addition to the identification and interpretation of data, methodologies for making required economic adjustments are subject to error. Most agree that a suitable discount rate is appropriate for reflecting the time value of money. Yet, even skilled practitioners have had difficulty applying this principle. For example, a recent DOD Inspector General report stated: "Adjustments should be made for the time value of money because several years may elapse between the time 'up front' investments are made and the time when the second source can effectively compete."[2] Yet, in adjusting for the time value of money, they used a 10 percent *factor* rather than a *rate* to assess costs of several competitive programs. This failure to apply its stipulated methodology correctly caused a substantial understatement of non-recurring costs.[3]

The treatment of low-rate initial production units for the sole source has caused problems.[4] Specifically, are they part of development cost or should they be incorporated into the learning curve?[5] This is more than an academic issue because those units are often relatively expensive and, as a consequence, their omission may significantly change the sole source cost profile.

The Baseline

The Institute for Defense Analysis developed the baseline methodology for estimating the effects of competition on recurring production costs in 1974.[6] This methodology consists of extrapolating the sole-source learning curve as the basis for estimating the sole-source cost for producing the entire competitive quantity. The difference between the actual and estimated costs is attributed to competition as either an added cost or savings.

This methodology is commendable for its simplicity which allows competitive programs with more than one initial sole-source lot to be measured by the same yardstick. But this simplicity has exposed it to criticism that results are misleading because it neglects important factors.

Many factors influence the slope of learning curves. They include, among others, changes in production rate, tooling, capital equipment and facilities, and product design as well as management strategy. However, learning curves conceal individual effects of these factors by lumping them together.

Critics of the baseline methodology have focused primarily on three issues that bias or limit the resulting estimates.

—The sole-source curve may reflect management's response to an impending competition. Therefore, it does not accurately indicate what its behavior would have been without a competitive threat. For example, management may have elected to charge a higher price to skim greater profits by exploiting its transient monopoly position, or it may have set a lower price to deter the creation of a competitor.[7]

—Sole-source learning curves based upon price may mask important shifts in cost and/or profits. For example, extrapolating a learning curve that incorporated significant profit reductions or increases between the first and second lots implies that profit would continue to shrink or grow steadily as quantity increased. This is an improbable outcome.

—Learning curves do not treat production-rate effects explicitly. Therefore, a significant rate increase or decrease during competition could cause related price changes by the initial source to be wrongly attributed to competition.

Alternative Methods

Alternative analytical methods have been employeed to correct these problems. They have faults of their own, some of which are discussed below.

Sole-source learning curves based on cost instead of price seek to avoid problems caused by significant profit shifts at the beginning of a program. While such curves give a more accurate picture of initial source behavior regarding cost, they omit consideration of a key factor related to competition: management decisions about acceptable/achievable profit levels. Additionally, cost data (exclusive of profit) are often unattainable which, thereby, cause this methodology to impede interprogram comparisons.

Another alternative methodology constrains the sole source to customary and reasonable values for learning curve and/or production-rate slopes. This is done to obtain a sole-source estimate devoid of competitive strategies. However, such a wide range of values comprise industry norms that a "typical value" may be significantly too high or too low for a given case. Thus, prescription of incorrect values could misstate the magnitude or even the direction of the competitive effect.

Several variations of another alternative methodology treat production rate as an independent variable to eliminate the annual cost effects of production build-ups or slow-downs. The idea is that dramatic rate shifts may mask the effects of competition on price. Difficulty in obtaining accurate data is a fundamental problem with this methodology. Annual procurement quantities commonly serve as proxies for production rate because they are easier to obtain than data related to annual deliveries. But, the two may vary significantly. Furthermore, adept scheduling has avoided dramatic rate variances implied by large shifts in annual procurement quantities.

Accurate annual quantity data are necessary but not sufficient to determine rate effects on cost. Product-oriented plants that produce unique end-items (e.g., assembly of Sparrow missiles) may have different optimal production rates (i.e., Raytheon could be more efficient at a higher or lower rate than GD). In other cases, cost effects attributed to rate may be due to other activities at the plant (e.g., Raytheon's production cost for Sparrow might increase or decrease in accordance with production rates for Phoenix, SM-2, Sidewinder, and Maverick).

Thus, effects of production rate on competitive costs may be more apparent than real. They may lead to self-fulfilling prophecies. Consider the following example where initial source excess capacity leads to "competitive savings":

Firm A has special tooling and test equipment sufficient for producing 1000 units per year. A subsequent program budget reduction limits it to 600 units per year. Its costs are higher than estimated. The government establishes Firm B as a second source to produce up to 60 percent of the new annual quantity (360 units per year). B submits a lower bid than A for the initial split-buy because its tooling is appropriate for the new rate (i.e., 360 vs. 1000 units per year). And the government chalks up another competitive cost saving.

All of the alternative methodologies introduce problems of their own making into the analytical process. Moreover, there is a problem common to all methodologies. They focus on individual programs.

Common Problem

No methodology has been developed that looks at the causes of competitive behavior and the effects of competition above the individual program level; specifically, at how firms have managed their mix of programs to achieve optimal returns and how broader economic conditions have effected competitiveness.

Competition has expanded the focus of defense industry management[8] to consider overall profitability as

opposed to the welfare of individual fiefdoms. Now, competitive bid decisions more often consider the effect of a program on amortizing fixed overhead and, therefore, increasing the profitability of programs already in-house. They also weigh technical synergy with other programs or new business growth targets.

A downside to this greater management perspective is the shifting of costs to "protected programs." Black programs have grown substantially since the expansion of competition and anecdotes about their relatively high overheads abound. Without a systematic analysis of the effects of competitive programs on a contractor's total business it is impossible to determine how the government has fared overall.

Survival is an even more compelling incentive than strategy. Some analysts have suggested the importance of industry capacity in determining competitiveness. This factor is evident in ship building where excess industry capacity has combined with competition to generate dramatic projected savings. Management's choice has been clear: bid at a loss and hope to recover through subsequent changes or go out of business. And competitive savings are projected based upon fixed price incentive contracts. They may disappear if the government's ultimate choice is between causing a contractor to file for bankruptcy or terminating it for default rather than paying a higher price.

Conclusions

It is important to put objections to the baseline and alternative analytical methodologies into the proper perspective. Each has its faults. But, when used appropriately and their results are interpreted with restraint, important about the "what, how, and why" of competitive cases follow. Still, single-point estimates of added costs or savings attributed to competition should receive little confidence.

Furthermore, our inability to estimate economic effects of competition with confidence implies that models purporting to forecast the economic benefits are irrational. The number of important variables that are not captured by historical data would necessarily be absent in a predictive model and, therefore, similarly limit its validity.

All the issues raised above notwithstanding, the push toward joint ventures or teamed development programs leading to production competition has changed the nature of the baseline in at least two important respects:

—The "perfect information" gained by involvement in a program from the beginning should eliminate bids by an ignorant second source that have provided competitive savings.

—When two firms are involved in a development, it is not clear how their learning curves would compare with a "typical" sole-source curve.

Thus, the rules of the game have changes so significantly that even accurate estimates of the economic effects of "typical dual source competition" may not be relevant for current acquisition strategies.

Endnotes

1. They are often funded under a separate contract with the developer.

2. DoDIG, *Report on the Audit of Dual-Source Procurement Techniques* (Report No. 88-163), June 7, 1988, p. 5.

3. *Ibid*, "Analysis of Investment Costs," p. 37.

4. Second source LRIP usually constitutes an educational buy. The difference between that price and the current sole-source price for the same quantity is treated as either a debit or credit in calculating non-recurring costs.

5. A reasonable convention is to count them as production units if they were produced by hard tooling and/or became operational (vs. test) units.

6. Zusman, Morris, *et al, A Quantitative Examination of Cost-Quantity Relationships, Competition During Reprocurement, and Military Versus Commercial Prices for Three Types of Vehicles*, AD 784 335, Institute for Defense Analysis, March 1974.

7. In the vast majority of competitive cases with more than two sole-source lots, the final sole-source point has been substantially below the learning-curve slope. This means that the sole-source baseline for the competitive estimate is often above the last sole source buy (i.e., it is assumed that the initial competitive buy will be at a higher price than the final sole-source buy). Thus, the baseline model has often provided estimates of competitive savings than logic would support. But, there is no statistically acceptable way of weighting a particular data point.

8. At least for the management of firms that have fared well under competition.

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DSMC PUBLICATIONS

(Continued from page 15)

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Robert W. Ball

TOTAL QUALITY MANAGEMENT READING LIST

Robert A. Wehrle

The defense budget, like a huge boulder, rests squarely in the path of a glacier. The momentum to balance the federal budget is only beginning to build. Having been institutionalized by the Gramm-Rudman-Hollings Act, it is a trend that will not soon die. In the face of decreasing budgets, a zealous press and obvious cases of inefficiency, the Secretary of Defense declared Total Quality Management (TQM) as top priority to help cut costs and improve efficiency. As part of the implementation effort, a TQM reading list was published. In this article, I examine and summarize contents of that list.

The TQM reading list at Table 1 can be put into three classes of books:

—*Foundation*, books providing the bedrock upon which TQM has been built. Interestingly, all are written by Western authors.

—*Japanese Technique*, books describing the Oriental process, written by Eastern and Western authors.

—*U.S. Technique*, books describing application of Japanese techniques in the Western business world, written exclusively by Western authors.

Table 2 shows the TQM reading list according to this classification.

Even cursory reading of books on this list reveals TQM is not a magic elixir. It is not a new and innovative way of doing business.

So, just what is TQM? The TQM effort is a school of thought; how *you* define it depends to an extent on *your* perspective.

—From a senior management perspective, TQM can be viewed as a long-term commitment to improve organizational communication, efficiency, productivity, competitiveness and product quality.

—From a middle-management perspective, TQM can be thought of as a collection of technical, statistical and management techniques used to improve processes within their organization.

—From a labor perspective, TQM is as much an educational opportunity as it is a chance to let the boss know how to improve the job in a non-threatening environment.

Total Quality Management can and will improve a company's efficiency and productivity and, ultimately, the bottom line. Initial results may be near miraculous but emphasis must be on the long term—on achieving multiple, minute victories rather than on a few dramatic leaps.

Wonder stories about implementation of TQM in the United States are more of a testament to inefficient processes used by the company rather than efficacy of the system. In a way they are dangerous, focusing on short-term, immediate payoffs, the antithesis of a well-formulated and properly employed TQM program. Total Quality Management is not about immediate payoffs even though that result may be achieved; it is about a *different* way of doing business and that implies long-term commitment.

There are many common themes in this TQM collection of books.

—To succeed, TQM requires a sustained, top-down commitment.

—Implementation should be bottom up.

—Continuous education at all levels is required to provide an environment where TQM can succeed.

—Focus on improving the process, not the product.

—Specialists hinder rather than enhance a quality program.

—Listen to the customers.

The one note of discord lies in using the reward system. Most authors favor a recognition program for internally marketing total quality management. Only Deming and Scherkenbach argue that reward systems are counterproductive; despite their minority position, they offer compelling reasons to examine reward programs to ensure they are focused properly.

Mr. Wehrle is a 1972 graduate of the U.S. Naval Academy. After serving 10 years as a Marine infantry officer, Mr. Wehrle joined TRW where he has been a member of the technical staff, section head and, most recently, a project engineer. He is currently working on the Ground Based Free Electron Laser Project. He has read every book on the OSD TQM reading list.

TABLE 1. TQM READING LIST

The key to effective and successful implementation of TQM is understanding underlying philosophy and theories supporting continuous process improvement efforts. The DOD and industry personnel need not wait for formal training or indoctrination. The following books are some of the best in the field of continuous process improvement. They should provide a sound basis for understanding the DOD TQM philosophy and vision.

Crosby, Philip B.: *Quality Is Free*, McGraw-Hill Book Company, New York, 1979.

Deming, W. Edwards: *Out of the Crisis*, Massachusetts Institute of Technology, Center for Advanced Engineering Study, Cambridge, Mass., 1986.

Feigenbaum, Amand V.: *Total Quality Control*, McGraw-Hill Book Company, New York, 1983.

Harrington, H. James: *The Improvement Process*, McGraw-Hill Book Company, New York, 1987.

Imai, Masaaki: *Kaizen*, Random House, New York, 1986.

Ishikawa, Kaoru: *What is Total Quality Control?*, Prentice-Hall, Englewood Cliffs, N.J., 1985.

Juran, J. M.: *Managerial Breakthrough*, McGraw-Hill Book Company, New York, 1964.

Scherkenbach, William: *The Deming Route to Quality and Productivity*, Cee Press, Washington, D.C., 1986.

Schonberger, Richard J.: *Japanese Manufacturing Techniques: Nine Hidden Lessons in Simplicity*, The Free Press, New York, 1982.

Townsend, Patrick L.: *Commit to Quality*, John Weiley and Sons, New York, 1986.

The Books

Fundamentals of quality control were originally published in 1951 in the textbook *Total Quality Control* by A. V. Feigenbaum, who devotes more than 200 pages to techniques associated with statistical quality control. His Technology Triangle provides an excellent overview of the quality engineering field. His treatment of the cost of quality is particularly useful.

In 1964, Robert Juran authored *Managerial Breakthrough*, thesis being there are two important elements to business management. He dubs them breakthrough and control management, and devotes the book to detailing the process for each. Juran defines control management as "...staying on course, adherence to a standard, prevention of change." Breakthrough management is "change, a dynamic, decisive movement to new, higher levels of performance." As it turns out, Juran's work captures the difference between management styles of West and East. Imai points out that Western managers tend to focus almost exclusively on innovation (breakthrough); Eastern managers on process maintenance and improvement (control).

Deming's well-known "14 points" from *Out of the Crisis*, and Scherkenbach's treatment of those points in his book, *The Deming Route*, provide excellent coverage of fundamental issues and techniques required to focus on quality. Their books, terse, pithy and well illustrated, are not particularly easy to read but your effort will be rewarded.

Japanese Techniques

The phenomenal success of the Japanese manufacturing community focused attention of the Western world on Eastern management practices. The three books devoted to a description of the Japanese approach to manufacturing provide thorough, in-depth and readable accounts of "inner workings and hidden mechanisms" of total quality management.

TABLE 2. TQM BOOK CLASSIFICATION

FOUNDATION	JAPANESE	UNITED STATES
Managerial Breakthrough	Kaizen	Commit to Quality
Total Quality Control	Japanese Manufacturing Techniques	Quality Is Free
Out of the Crisis	What Is Total Quality Control?	The Improvement Process
The Deming Route		

Imai's *Kaizen* devotes a chapter to stumbling blocks facing Western society if they are to implement TQM successfully. Perhaps the most telling comment in the book is that U.S. manufacturers must not abandon expertise in breakthrough and innovation management but, rather, supplement it with lessons learned by the Japanese.

Ishikawa's book provides a cogent analysis of limitations of standards, particularly misuse of standards by the American manufacturing community. He introduces the concept of a quality-control audit at several levles. His comments on why the Zero Defects Program failed in the United States provide a roadmap of pitfalls to avoid if total quality management is to succeed. Both books, written by individuals with solid credentials, are easy reading and packed with practical and theoretical advice.

The strength of *Japanese Manufacturing Techniques* by Schonberger lies in his analysis of Japanese manufacturing techniques from a Western perspective. Devoting the last chapter to "The Prospects of Catching Up," his analysis is upbeat and encouraging. Schonberger says

> [U.S.] Industry is ready to change its ways, and now we know what to do: simplify and reduce, simplify and integrate, simplify and expect results.

U.S. Techniques

Economic competition on a global scale is a reality touching the lives of all Americans. Dr. H. J. Harrington points out in *The Improvement Process* that the future economic battleground will concern quality. His book is an overview of quality management from different levels; however, he writes primarily from the senior-management perspective. The chapter on "System Improvement" is worth reading.

Philip Crosby's *Quality Is Free* is an account of how ITT successfully employs total quality management principles. Chapters on the cost of quality and the Quality Management Maturity Grid are excellent. The chapter on the "Make Certain" program may be most valuable for the military. It provides questions that force you to think about the job of "moving and shooting" in terms of customers and products.

Patrick Townsend, former Marine, gives an account of how the Paul Revere Company uses total quality management principles in *Commit to Quality* which details the process required to implement TQM successfully in a service industry. He explains how the quality-circles concept has been expanded and improved. The book, good reading, is probably the best model existing today for TQM in the military. The adage for survival on the battlefield exhorting the commander to "move, shoot and communicate," can be adapted to the message contained in these books.

If the commander is to employ TQM successfully in his command today he must "simplify, integrate and communicate."

THE COPERNICUS SYNDROME

Colonel W. H. Freestone, Jr., USA

One of the hottest topics in the defense acquisition business concerns application of advanced technology products to user systems; to be more specific, electronic components. When one reads about advanced technology, for the most part, the real action is in the world of electronic devices because of their ever-improving capabilities. In the June 8, 1989, *Christian Science Monitor*, "Pentagon Arms Suffer From High-Tech Gap" points out "the new B-2 Stealth Bomber and the SSN-21 Seawolf Submarine are chockful of 'high technology'." Yet, these symbols of U.S. industrial capability reportedly have computer chips in key spots that are said to be todays "run-of-the-mill, not state-of-the-art" products.

Non-Developmental Procurement

Lately, to alleviate the problem, there has been considerable support for non-developmental item (NDI) procurement to overcome the electronic technology lag in Department of Defense system development. Another parallel concept is commercial off-the-shelf (COTS) purchases. Both of these acquisition methods sound like a sensible way to deal with the problem of system obsolescence, while at the same time saving money; off-the-shelf purchases would tend to provide opportunities for volume purchase of products already existing. In many cases, NDI/COTS is the best acquisition method. Is there anything wrong with this as a total approach?

The answer, simply stated, is: One cannot purchase everything "off the shelf" to win a war. The reason is that all parties to a potential conflict might have the same opportunity for weapon system development. Also, one must consider what is available for purchase off-the-shelf. In the world of military electronics, opportunities are found primarily in the support (tail) areas; i.e., radios, telephones, computers, trucks, etc. Therefore, applying the NDI/COTS philosophy to purchase "commercially available" combat (tooth) systems might result in no battlefield advantage to either side of a potential conflict except in total numbers of systems.

Bureaucracy

In the process of trying to develop appropriate new fighting capabilities, the United States military establishment must deal with regulations governing acquisition. With respect to the technology-lag problem, some in government say the peacetime procurement process is too complicated. Industry, on the other hand, says the basic problem is that government over specifies its requirements. There may be some truth to this charge on a case-by-case basis. Those making that claim, however, assume all manufacturers work to the same standards.

Role of Industry

Current acquisition rules require the military using community to write a "performance" oriented requirement statement, called the Required Operational Capability (ROC), which drives the entire acquisition process. How the ROC is written determines what industry will deliver. Conventional practice says that in writing a ROC you should not tell the manufacturing community how to build the needed item. The writer of a ROC is requested to provide only a general explanation of a needed capability. Regulations provide that a weapon system manufacturer should be allowed to decide what is the best technical approach.

In the final analysis, the manufacturer selects technology that eventually is in the delivered system, based on price competition. The only parameters measured by government regulation are *cost, schedule, operational performance, and integrated logistics support*. This does not mean individual project/product managers do not enter into a dialogue on the effect technology has on the technical performance of their systems. In some cases, considerable influence is wielded by a given manager. Whatever is done with respect to measuring system technical performance and technology, if it is accomplished at all, is on an *ad hoc* basis.

Appliance Method of Acquisition

Because there is nothing in the current acquisition process measuring system technical performance, a comparison may be made between purchase of an appliance and acquisition of a weapon system.

To illustrate—if the lady of a particular household writes a performance-oriented ROC, based on a desired capability in the kitchen, it might go like this.

"System desired to cool milk to 40 degrees Fahrenheit, maintain that temperature constant for 30 days, contain 20 cubic feet of internal milk storage space, be human transportable, weigh no more than 300 pounds, be covered by a warranty, and be field repairable on site, (at the home)."

When the man of this household sets off (as project manager) for the desired system, he interfaces with a manufacturer's representative at the local appliance store. Negotiations toward meeting desired operational capability described in the ROC are focused on system

characteristics described in the ROC, and on price. Once the model is selected, price is determined and payment method agreed upon; and arrangements made for delivery of the system. A new equipment fielding team provided by the manufacturer's representative installs the new system and explains its operation.

Within the first 24 hours of operation, however, the system failed, causing milk to spoil. The lady summoned the "project manager" to demand an explanation. A repair person was requested. On close examination, the repair person said the system's coolant compressor failed. The repair person points out the compressor was based on a no-longer-used, obsolete design. The project manager quickly returns to the appliance store for an explanation. The store manager points out that compressor obsolescence was never discussed in the purchase negotiation; the cooling system purchased was "on sale." Unfortunately, it was the real user, with the system in actual field operation, who experienced the effect of a lack of dialogue concerning technical performance of the milk cooling system's internal operating system.

Nicolai Copernicus

Astronomer Nicolai Copernicus (1473-1543) told mankind the earth is not the true center of the universe. According to the *Encyclopaedia Britanica*, mankind had difficulty dealing with this news.

For centuries, everyone believed the earth stood still, the sun revolving around it. When it was shown the reverse is true, and that mankind had the whole thing backwards, it caused much re-thinking and re-education.

What has this to do with technology and the acquisition process?

Today, the acquisition process places focus for technology application with the system project manager and his industry counterpart. The current center of the acquisition universe is backwards. The true center of the acquisition universe is the user, who writes the required operational capability statement, ultimately using what is produced. Yet, it is the user, as writer of the ROC, who is not required to know or address anything about technical performance of a system. As a result, from the start, there is nothing contained in the acquisition process, by regulation, tied to the technology the acquisition process seeks to acquire.

To understand why this is true, one needs to revert to origins of current acquisition regulations. Begun in the early 1960s under the aegis of OMB Circular-109, the current process was founded on the philosophical grounds of price competition, to lower purchase costs, and to strengthen the U.S. industrial base. At the same time, it sought to reduce negative competition among military Services for budgetary dollars. Interestingly enough, during the same early 1960s, the electronic-integrated circuit was finding its way into military and commercial products. From then until now, the electronic integrated circuit has grown by leaps and bounds, while the process that seeks to harness its power remains philosophically frozen in the early 1960s. Thus, the current acquisition process remains primitive in comparison to technology it seeks to acquire. What does exist is a continuing expansion of the current empire of obsolescence. This empire is built on the assumption that competing contractors will ensure state-of-the-art electronic components will be a part of weapon system development through a process that, for the most part, leaves the final technology decision up to them.

Solution

What can be done to change current regulations to ensure that writers of requirements for new systems and upgrades to existing systems take full advantage of advanced electronic technology? For the answer, one must look at advances in electronic device design and development. Simply stated, a new element should be added to the current acquisition process based on electronic technology advances called *System Technical Performance*. What would be in this new element?

System Technical Performance would include many things.

—A purchase decision made on life-cycle cost rather than current purchase price alone. Reason: advanced microelectronic devices tend to be more reliable than older generations of devices, thus lowering the cost of maintaining a system.

—A question concerning upward compatibility with succeeding generations of electronic-integrated circuits. Computer aided system design today looks to the use of a "hardware description" software language to facilitate a design engineer's job of keeping pace with changes in the evolutionary development of electronic devices; thus, further reducing costs during the life of a system.

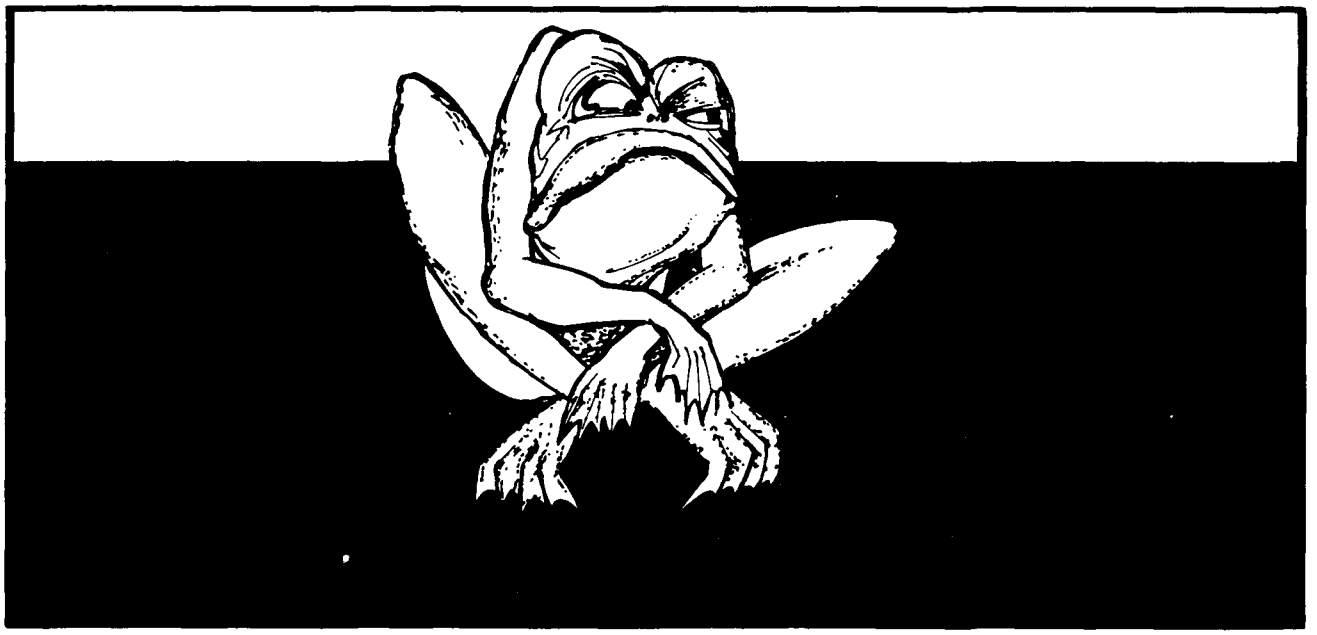
—A question on whether computer aided design/engineering was being used in developing a system (to capture design of the system to facilitate future changes). If old manufacturing ways are in use, the increased cost of obsolete manufacturing will continue to be passed on to the Department of Defense.

—A question if a given systems electronic architecture is being designed to permit/facilitate pre-planned product improvement at a later date. The right electronic architecture will make additions to a system easier once it is in the

(See FREESTONE, page 28)

ORGANIZATIONAL COMMUNICATIONS

David C. Rich



You are finally in charge. You have been selected program manager for the new project. The first thing you do is present your job expectations to the organization. Usually, because of office size, emergent requirements, travel plans, etc., an immediate face-to-face meeting with the entire staff is not practical, but you want to explain your expectations. You have chosen the method, arranged your thoughts and sent the message. Now what? *How* do you determine if the message was received and understood?

When you become leader of this new organization, reflect on how well your office transfers information. Does everyone know the organizational mission and goals? Is everyone working for the same end-product?

Even though many managers take communications for granted, research shows in most offices not enough attention is given to how information is passed from people making policy decisions to the rank-and-file workers who make it happen. Studies show lack of clear and concrete direction causes confusion and disarray.

Listening closely to the "grapevine," you may hear a "grumbling" that information is not available to people needing it. Whether real or perceived, this is a problem. What an employee perceives is true until proved otherwise.

It is important for a good manager to take a periodic pulse of the work environment and determine if anything is detrimental to accomplishing organizational goals on time and within cost. Communication is an important, effective tool for management. If lines of communication are not clear, solution to a problem could elude you.

In 1953, someone described the communication process this way: A *communicator* (speaker/sender/issuer) *transmits* (says/sends/issues) *messages* (orders/reports/suggestions) to a *communicatee* (addressee/respondent/audience) to influence behavior of that communicatee as seen in his/her *response* (reply/reaction).

The situation is almost the same today as it was 36 years ago. Good communication at all levels is necessary for smooth operation and clear understanding of Command goals and objectives.

Communication is a dynamic process when people exchange ideas by expressing attitudes and requirements. It involves transmitting a message, receiving the message and, possibly, acting on the message. Communication can be formal or informal but, mostly, it is a dynamic information system.

Using good communication in an organization is extremely important for sharing ideas, expressing requirements, accepting change, and forcing thought. Sharing ideas through the free-flow method overcomes differences and minimizes misunderstanding.

Members of an organization deserve to know job requirements they are to meet. Workers not given adequate direction will do whatever they think necessary and acceptable for the job. Accurate communication of requirements is the only way they will get information. In a work environment, managers have the responsibility for effectively communicating requirements. It is their duty to relate their wishes as clearly as possible.

Good communication forces a manager to evaluate a situation carefully before implementation. Accepting change, never easy, can be perceived as risky because it can mean the "old way" is not acceptable. Meaningful dialogue eases pain of transition by increasing understanding; if understanding is lacking, change will probably fail. An approach providing for many people to review a plan when errors in judgment can be eliminated beforehand is better than implementing a plan with critical flaws.

Ideas to share with others need to be put into words, actions or signals that can be understood by receiver. This is not easy; when ideas do not match the transmitted words or actions, confusion surrounds the requirement. This can be complicated by misusing words that have different meanings for different people.

Only after the message is in clear and specific words should actions or signals be sent to the receiver. Even a properly formed message can become garbled. When a message is sent in the din of operating machinery or in technical jargon, there is no assurance the message has been received adequately.

Acknowledging the message needs affirmation by feedback directly and indirectly. In the *direct* method the receivers might respond with questions or recommendations indicating they understand the message; or, receivers might indicate *indirectly* having received the message by actually performing the request.

Research shows poor communication is a problem in major corporations. For any organization to adapt readily to ever-changing environments, effective communication at all levels is a necessity.

Communications in most program offices can be put into four categories: *administrative, technical, cultural* and *systems specific*.

Administrative includes pay and pay raises, pay days, annual and sick leave, working hours, parking, holidays, health and life insurance, eating facilities, retirement, etc. These are important and must be addressed adequately because they form basic elements of Herzberg's and Maslov's hierarchy of needs; if not fulfilled, concentrating on work will be diminished.

Technical communication includes items like exchanging pertinent information between agents of the same discipline—engineering, accounting, contracts, personnel, etc. Clear and precise dissemination of information is important if changes or advancements in their particular field, and integration of new and related ideas are to be handled expeditiously.

Cultural communication is important when dealing with a mix of cultures; i.e., military and civilian communities. Some things a civilian needs to know are uniqueness of specific Service, history and traditions, military customs, commissioned officer and enlisted members' insignias and rank, and military time and dates. It is important for the military to understand the civilian personnel system, job categories, rating systems and things affecting careers and promotions. These differences can bear on things that are done and said.

Communication that is systems specific includes numbers of people employed by the organization, importance of system you are working on, how many are employed in your office and in the field, and outputs produced by the organization.

Peter F. Drucker in *People and Performance: The Best Of Peter Drucker*, writes about good management practices:

> The manager has a specific tool: Information. He doesn't "handle" people, but instead he motivates, guides, organizes people to do their own work. His tool—his only tool—to do this is the spoken or written word or the language of numbers. It does not matter whether the manager's job is engineering, accounting, or selling, to be effective, a manager must have the ability to speak and to write. Managers need skill in getting their thinking across to people.

Good and effective communication requires hard work and rewards can be enormous and worthwhile. Obvious rewards are better understanding, higher morale, less stress, and more enthusiasm by management and employees. With these results achieved, it puts the organization ahead of the competition and places managers in a leadership status. A more comfortable and efficient work group leads to greater productivity.

Interviews with senior- and mid-managers in project offices indicate good communication is a paramount objective.

Sometimes, organization size hampers its effectiveness. Most paramilitary organizations are matrix in nature; therefore, there is information running horizontally and vertically at

the same time. Have you wondered what similarity to reality an item of information looks like when reaching its final destination?

As organization size expands and control increases, it is possible management may think a fire is out in one area only to have it break out elsewhere.

Psychological barriers are caused by the organization's atmosphere. For a communication system to thrive, it must be in an organization where management wants to hear problems, and where there is a fair dealing of ideas.

Language and intent are common barriers to good communication; clear and simple communication overcomes this problem. Sometimes, the language of motivation, not the language of production and efficiency, is required for an extra level of performance. Formidable barriers can be caused by technical specialties, especially in the areas of highly educated engineers and scientists. Technical languages used by professional specialists often become so engrained that they have difficulty communicating with someone not in the specialized field. These barriers, if understood, diminish with effective communication.

Literature reveals there is continuous debate whether there is a problem with communication and what, if any, effect it has on productivity. Upward communication ("the boss never listens"), downward communication ("the troops never seem to get the word"), sideways communication ("why is Department X doing that, don't they know what we just did?") is an ongoing problem, sometimes repairable in bits and pieces.

Jablin (1987) said communication, exchange of information among people, is a linking-process need for all managerial activities. Effective communication is necessary for people to work together and attain organizational objectives. With acquisition organizations being parts of larger and multifaceted service organizations, a solid communication chain is necessary to bond and fuse that organization toward specific goals. When links are missing, the chain is weakened or destroyed.

The kingpin, says D'Aprix (1987), of any employee communication effort is the common, garden-variety manager. Whether we call this person a program manager, department head, supervisor, group leader, or head of something-or-other is unimportant. He or she carries the brunt of the communication effort in traditional hierarchical organizations. Through such people, doers in the organization make contact. When the hands-on and doers of the organization become leaders and supervisors, this may cause problems. Without proper training and guidance, an excellent engineer speaking the language of other engineers and technicians sometimes has problems relaying management's viewpoints on proper timekeeping procedures or company health plan coverage. These problems can be overcome but often we put people in charge because they are subject-matter experts, and ignore the necessary manager/leadership training aspect.

How much information should you pass along? David Acker (1985) contends it is better to pass too much information down the chain of command, while Sanderlin (1987) claims a common mistake made in business is assuming more data are the same as more and better communication. Sanderlin contends information overload can make people feel inadequate because they cannot comprehend everything forwarded to them; this tends to cause cynicism about all communication efforts.

A good example of system overload is the influx of new computer systems. With the space available, there is a push to load everything available on the computer data base to become a "paperless society." Everyone wants to copy all files on the machines because

"If we dump 'garbage' into systems without giving it a 'reality check' we unwittingly will dump this 'garbage' back out and call it progress.

FIGURE 1. COMMUNICATION AUDIT— RECEIVING INFORMATION FROM OTHERS

We receive information daily about different topics in our organizations. For each listed topic, mark response that best describes: (1) the amount of information you are receiving on that topic and (2) the amount of information you *need* to receive on that topic; that is, the amount you *have* to *have* to do your job.

TOPIC AREAS	THIS IS THE AMOUNT OF INFORMATION I RECEIVE NOW	THIS IS THE AMOUNT OF INFORMATION I *NEED* TO RECEIVE
A. How Well I Am Doing In My Job	1) 1 2 3 4 5	2) 1 2 3 4 5
B. My Job Duties	3) 1 2 3 4 5	4) 1 2 3 4 5
C. Organizational Policies	5) 1 2 3 4 5	6) 1 2 3 4 5
D. Pay and Benefit Changes	7) 1 2 3 4 5	8) 1 2 3 4 5
E. How Technological Changes Affect My Job	9) 1 2 3 4 5	10) 1 2 3 4 5
F. Mistakes and Failures of My Organizations	11) 1 2 3 4 5	12) 1 2 3 4 5
G. Performance Rating Criteria	13) 1 2 3 4 5	14) 1 2 3 4 5
H. How My Job-related Suggestions Are Being Handled	15) 1 2 3 4 5	16) 1 2 3 4 5
I. How Organizational Decisions Are Made that Affect My Job	17) 1 2 3 4 5	18) 1 2 3 4 5
J. Promotion and Advancement Opportunities in My Organization	19) 1 2 3 4 5	20) 1 2 3 4 5

RESPONSE CODES

1 = Very Little
2 = Little
3 = Some
4 = Great
5 = Very Great

it seems to "be the thing to do." The researcher contends if we dump "garbage" into systems without giving it a "reality check" we unwittingly will dump this "garbage" back out and call it progress.

Denny (1980) identified, isolated and diagnosed the "excelsior syndrome" for its muffling and padding effect on interorganizational communication. It usually results in losing motivation and productivity. Terms like "don't rock the boat," "the old way is the best way," and "we've tried it before" indicate there probably is need to improve communications.

Upward and downward communication, according to Inman (1985), is necessary to encourage employees to contribute ideas to improve efficiency in a company. If management promotes the free exchange of ideas, there is a better understanding at all levels. More democratic leadership brings greater satisfaction among workers and more loyalty and respect for the company. This translates into increased productivity and effectiveness.

Do you have an open-door policy? Or, at least, do you *think* you do? This policy is practiced or talked about in many offices and tends to be good for upward and downward communication if it is a *true* open-door policy. The major drawback is not the manager thinking his policy is in effect but, quite often, is the staff surrounding him; they try to "protect" him from perceived "noise" and "static" rather than advancing an honest attempt at communication. This usually happens without the manager's knowledge and *slams* the door on people honestly wanting to pass information up and down the chain of command.

How do you determine a communication problem in your organization? DiGaetani (1986) recommends a communication audit as an investigative research tool for finding usable information in the corporate communication system. An audit looks at organization well being and, at a minimum, perceives problems, real or imagined. Benefits of auditing the communication system include determining impact of new communication-related programs or policies, and assessing impact of ongoing policies and programs. Figure 1 provides a sample audit form, perfected by DiGaetani, to query members of your organization about perceptions versus perceived reality.

Peter D. Schiffrin in *All the Right Moves*, says "...when people know what types of rewards they can expect for reaching clear, well-derived goals for the organization, their behavior can be managed effectively. Often, though, employees do not receive information that could affect their performance; continual flow of information is important for people to do their jobs properly."

Authors Walter Bennis and Burt Nanus in *Leaders. The Strategies for Taking Charge*, say "...even the 'best' ideas are only as good as their ability

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to attract attention in the social environment. The conditions of that environment - organizations in this case - are inherently unpredictable: they can kill a good idea just as easily as a bad one.

"The main clue is that leadership creates a new audience for its ideas because it alters the shape of understanding by transmitting information in such a way that it 'fixes' and secures tradition. Leadership, by communicating meaning, creates a commonwealth of learning, and that, in turn, is what effective organizations are.

"What we see and experience in today's organizational landscape are cumbersome bureaucracies that more often than not betray the mismanagement of meaning. A 'great idea' is hatched. Responsibility is delegated. Then it is delegated again. Then it is redelegated."

Jerry Harvey in *Organizational Dynamics* (1977) provided a witty and caustic attack at the process of draining the organizational swamp. In his article, "Organizations as Phrog Farms," he described organizations as having two essential purposes. One is to produce widgets, glops, and fillips. The other is to turn people into phrogs. In many organizaions, the latter purpose takes precedence. Phrogs tend to live a solitary life in the swamp or, as one phrog said, "It's a lonely life on the lily pad." Phrogs compete with one another for insects, vie for the right to head the flicking order of the swamp, and are ultimately evaluated for what they do in their own mud flats. A common phrog maxim is: "You can't get involved with other phrogs in the swamp; someday you may have to appropriate their lily pads."

Phrogs speak the Language of Ribbit, simple because it contains only one word. When all phrogs croak "Ribbit," the swamp is noisy, but not a lot of real communication is exchanged. Accuracy of information is not important in the swamp. In fact, a person entering the swamp is told why the Language of Ribbit is the only possible language there, despite the fact that phrogs don't learn much from one another when they use it. Therefore, people have a difficult time talking with phrogs—in fact, they seldom talk with phrogs at all.

It is easy to get wrapped up in *your* importance and *your* position. If you don't pay attention to what is going on around you, I bet you wouldn't know when your organization is teetering on the edge of being eaten by the alligators.

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field; wrong electronic architecture might mean an entire system must be discarded/replaced to permit an upgrade.

—A question concerning using modular construction to reduce the number of internal circuit boards, and to facilitate standardization of printed circuit boards and maintenance.

—A question concerning using built-in-test circuitry to assist in reducing need for external test equipment and costly test program sets.

Conclusion

Additional questions might be appropriate to include in Department of Defense acquisition process regulations, as might questions concerning characteristics of other non-electronic technologies.

The thing to recognize, however, is the simple fact that current Department of Defense acquisition regulations do not have anything contained in them designed to evaluate the effect of applying modern electronic technology to weapon systems; that the electronic technology decision is made principally by the manufacturing community, based primarily on system purchase price; that the current acquisition process is philosophically founded in the early 1960s when the integrated circuit as we know it today did not exist. Most important, current regulations should ensure individuals writing Department of Defense system requirements are not required to address internal technical performance of the system they need. As a result, the user probably does not learn what might have been the range of technology possibilities or choices before finalizing the ROC.

If these observations seem out-of-step with what you have been led to believe, you could be feeling the effect of *the Copernicus syndrome*.

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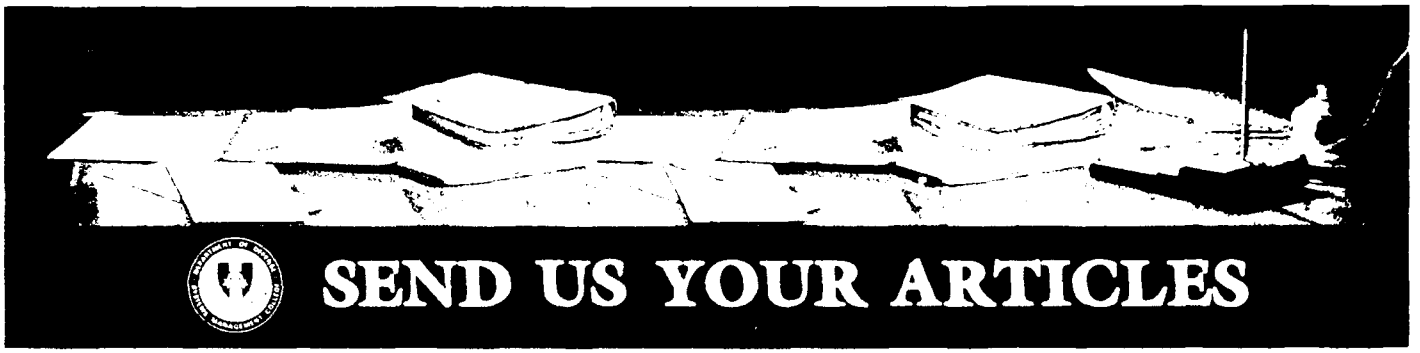

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